

Challenges in Using Superconductor-Semiconductor Hybrids as Model Systems to Study Quantum Phenomena

Ç. Kurdak

Department of Physics, University of Michigan, Ann Arbor, MI 48109

Systems of Al/AlO_x/Al tunnel junctions have long been used as model systems to study various quantum phenomena. Most properties of these systems are determined by the resistance and capacitance of the tunnel junctions which can be engineered by fabrication but cannot be varied *in situ* after the tunnel junctions are fabricated. On the other hand, in systems of semiconductors, many properties of the semiconductor can be varied using electrical gates. By using superconductor-semiconductor hybrid systems, we take advantage of the control that is achievable over the electrical properties of semiconductors in order to study fundamental quantum processes in systems with a Hamiltonian that can be controlled *in situ*. Such hybrids have been shown to be unique for the study of dissipation in quantum systems. When the tunnel junctions are placed on a GaAs/AlGaAs heterostructure with a two-dimensional electron gas near the top surface of the heterostructure, the dissipation of the system can be controlled by varying the resistance of the two-dimensional electron gas. I will give an overview of what has so far been achieved using such hybrids and discuss challenges in adding some other experimental knobs to achieve even higher degree of controllability.